Biosensor Detects Chemical Residues

Researchers are hoping a new biosensor may help farmers and regulatory officials detect herbicides in soil and water samples. The device relies on living organisms or their byproducts to identify traces of chemical residues in a matter of minutes.

Heavy applications of herbicides can leave environmentally unsafe residues in soil and water. The biosensor is made of a chlorophyll-protein complex—the green proteins in plants used for photosynthesis—fixed on electrodes that specifically measure oxygen levels. The complex produces oxygen in the presence of certain chemicals and light.

A liquid sample is passed through the biosensor. If the sample contains a herbicide, the chemical will react with the biosensor's proteins and inhibit oxygen production. The electrode in the biosensor detects oxygen levels and sends the information to a computer that displays the data in graph form.

The test is ultrasensitive and works well at room temperature or above. But "the chlorophyll-protein complex from plants such as potatoes, peas, and broad beans can't withstand high temperatures, so they are unsuitable for use as biosensors," says molecular biologist Autar K. Mattoo.

The new device instead uses a protein complex from a particular cyanobacterium—a bacterium that can fix carbon dioxide in the presence of light and can grow at very high temperatures—that isn't inactivated at warmer temperatures a user might encounter in the field.

"If a biosensor is to be used repeatedly, especially in the field, it requires a biosensing device that is stable at ambient temperatures and doesn't require cooling," says Mattoo.

The new biosensor is easy to use and economical—distinct advantages over currently available herbicide detectors. "Other sensors are reliable," says Mattoo. "But they require expensive equipment and lab analysis, limiting the number of samples that can be analyzed."

This biosensor can run repeated tests in the field. The scientists are working on a miniaturized commercial version that should be available within the next 2 to 3 years. Mattoo co-developed the biosensor with scientists from the Czech Republic and Italy through a grant supported by the North Atlantic Treaty Organization. More detailed information about this research will soon be published in the journal "Biotechnology and Bioengineering."—By **Tara Weaver,** ARS.

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A Little Bit of Yew Helps Insecticides

When a black vine weevil eats a yew leaf, it gets more than food. The same plant that gives the insect nutrients passes on a dose of a powerful chemical that can, when combined with certain pesticides, lead to the bug's death.

The weevils, *Otiorhynchus sulcatus,* invaded the United States from Europe in the early 1900s and are now a major pest of small fruits like strawberries and ornamentals like rhododendrons and begonias.

Scientists suspected the yew's qualities when they noticed that pyrethroid insecticides killed black vine weevils feeding on yew plants but not weevils on strawberries.

Robert P. Doss, a plant physiologist with the Agricultural Research Service, discovered why.

"We've isolated three chemicals in the yew that act as synergists to increase the effectiveness of pyrethroids," he says.

These are the first insecticidal synergists ever found in the yew, which has been widely studied as a source of anticancer compounds.

Doss works in the ARS Horticultural Crops Research Unit at Corvallis, Oregon. He collaborated with scientists at Oregon State University in Corvallis and Washington State University in Vancouver.

Pyrethroid insecticides are synthetic compounds based on pyrethrins, natural insecticides found in a certain type of chrysanthemum. They are popular because they are less toxic than some other commonly used chemicals.

Pyrethroid-based products often contain a synergist to increase their potency. For example, piperonyl butoxide dramatically increases the potency of insecticides that kill fleas on dogs and cats by disrupting a key enzyme involved in insecticide breakdown by the insect. Piperonyl butoxide is a synthetic version of a compound found in sesame seeds. Doss believes the yew insecticide synergists may work the same way.

The yew compounds have very complicated chemical structures and took nearly a decade to isolate.

"Right now, these chemicals would be prohibitively expensive to manufacture," Doss says. But discovering their structure paves the way for developing cheaper synthetic versions.

Doss' next step is to test the synergist-pyrethroid combination on other weevils, as well as on moths, crickets, and beetles that attack crops.—By **Kathryn Barry Stelljes,** ARS.

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